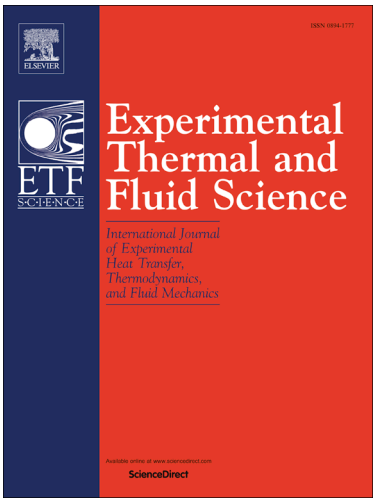

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Abstract

Plasma synthetic jet actuator (PSJA), which produces pulsed jets, is used to control the shock wave boundary layer interaction at a compression ramp at Ma=2.0. The flow topology of the wall transverse plasma jet (TPJ) from the PSJA is first visualized through particle laser scattering (PLS) photography. The PSJA aperture effect is also examined by comparing the jets out of the apertures of 1.2mm and 2mm respectively. The control effect is later investigated by both PLS and particle image velocimetry (PIV). Further, the interaction process between the TPJ and the ramp-induced separation is discussed. The results show that the flow is characterized by two typical structures: the jet plume and the trailing vortex structures similar as those produced in the wake of vortex generator. And the PSJA with larger jet aperture is found to generate a stronger jet plume and the trailing vortices with a deeper penetration. Moreover, the reduced interaction region is only observed with the wider aperture through PLS technique. For PIV measurement, some further evidence on the reduced separated flow is given. The vortex shedding in the velocity shear layer is enhanced by the jet plume and the trailing vortex structures. Subsequently, the reduction of the separation zone is revealed with the overall shear layer reduced, which indicates the momentum exchange between the shear layer and mainstream. At last, a conceptual model based on two typical structures is suggested to reveal the control process.
Keywords: transverse plasma jet; supersonic flow; shock wave/boundary layer interaction;

1. Introduction

Shock wave/boundary layer interaction(SWBLI) occurs frequently in supersonic flow. It may result in flow unsteadiness and large-scale boundary layer separation. These adverse effects reduce aerodynamic efficiency and potentially cause structure failure [1]. Therefore, flow control is needed to address those effects associated with SWBLI. Various active and passive control methods have been proposed so far. The micro vortex generator (MVG), a class of passive control device, is used to eliminate flow separation. Optimization of MVG geometry has been carried out by Zhang [2], Lee